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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/722,700	11/25/2003	Loucas Tsakalakos	139081-1	9948

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GENERAL ELECTRIC COMPANY (PCPI)
C/O FLETCHER YODER
P. O. BOX 692289
HOUSTON, TX 77269-2289

EXAMINER	
STADLER, REBECCA M	

ART UNIT	PAPER NUMBER
1754	

DATE MAILED: 09/14/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/722,700	Applicant(s) TSAKALAKOS ET AL.	
	Examiner Rebecca M. Stadler	Art Unit 1754	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *19 July 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *30,32-52,54 and 55* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *30, 32-52, 54 and 55* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Response to Arguments

Applicant's arguments filed June 16, 2006 have been fully considered but they are not persuasive.

Regarding applicant's argument that Xu teaches away from a conductive layer, the passage at column 6, lines 16-20 reads: "Although conductive, the growth layer may have some resistance to regulate emission current." The Examiner treats this passage as meaning that the layer is conductive, but that the layer has some level of resisitivity in order to regulate the electric current. Xu requires that this layer is sufficiently conductive to replace electrons lost by the emitter structures due to field emission (see Xu, column 6, lines 11-13). It is stressed that the layer is not fully resistive, rather the layer may have some resisitivity. In a field emitter device it would be desirable to have some resisitivity in order to regulate the electric current so that the electric current is not too high. Applicant argues as though the claim reads: "fully conductive." Rather, the claim merely requires that the epitaxial buffer layer be conductive, the layer in Xu is conductive as evinced by the passage above. The Examiner is unclear as to how a layer that replaces electrons would not be conductive. Applicant is invited to submit evidence that the layer of Xu that replaces electrons is not conductive.

Regarding applicant's argument that Xu does not teach a conducitve platform, even taking the entire specification into consideration, there is nothing in the specification to suggest that Figure 4 is "to scale." Xu teaches a metal catalyst film, which is considered to be a "platform" because it is raised off the substrate, it will facilitate nanotube growth, it will raise the level of nanorods closer to the gate opening. This is especially true considering that the invention is on the nanoscale. Even raising the nanorods by 1 nm will have a difference in the very small-scale field emitter device. Ultimately, the metal catalyst film of Xu meets the claim limitations, even if Xu placed the film there for different reasons. Claim 44 recites a conductive platform having a top surface, disposed on the top side of the substrate within the cavity and has a nanorod affixed to the top surface. The metal catalyst film of Xu has a top surface, it is disposed on the top side of the substrate within the cavity and has a nanorod affixed to the top

surface. Again, applicant argues as though a size or thickness limitation is recited. If there is a criticality to the size, thickness, or composition of the conductive platform, the Examiner suggests adding these limitations to the claim.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 30, 35, 36, 38-40, 42-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum.

As to claims 30, 38, and 40, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is

called a patterned gate metal film); and carbon fiber emitters (nanorods) (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly. Xu '444 teaches a conductive layer on top of the substrate (see column 6, lines 11-29, in particular lines 17-19). However, Xu does not teach that the layer is an epitaxial layer. Linthicum '198 discloses a microelectronic device having an epitaxially grown layer of 3C-silicon carbide on a converted (111) silicon layer. A layer of 2H-gallium nitride, which is dielectric, is then grown on the epitaxially grown layer of 3C-silicon carbide (see abstract lines 1-6). It would have been obvious to one of ordinary skill in the art at the time of this invention to use an epitaxial layer (as in Linthicum) on the substrate of Xu in order to take advantage of the reduced defects produced by epitaxial growth (see Linthicum column 1, lines 54-60).

As to claim 44, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is called a patterned gate metal film); Xu discloses a catalyst metal film (since the catalyst is metal, it will serve as a conductive platform) on top of the substrate; with carbon fiber emitters (nanorods) on the metal (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly.

With regard to claims 35 and 48, the substrate of Xu can be an inorganic monocrystalline substance (see column 6, lines 33-35). Specifically, a silicon wafer can be used (see column 20, lines 12-14).

As to claim 42, Xu '444 discloses carbon fiber emitters having diameters of 20-100 nm (see column 19 lines 65-67).

As to claim 43, Xu discloses carburized metal (referred to as carbon fiber emitters) (see column 9, lines 25-32). Xu teaches a silicon carbide (see column 9, lines 30-31). Although Xu does not disclose where the carburized metal is from, it would have been obvious to use any of the metal oxides claimed in the present invention to provide the carburized metals.

As to claim 45, Xu '444 discloses a structure on top of the substrate, which can be a cone (see column 14, lines 22-32).

As to claim 46, Xu '444 teaches that the catalyst (the conductive layer) can be a transition metal, including molybdenum, platinum, palladium and niobium (see column 9, lines 26-39).

As to claim 47, Xu '444 discloses that the fiber emitter (nanorod) can be a carbide (see column 9, lines 25-32).

As to claims 50 and 51, Xu '444 discloses that the substrate can be a polycrystalline material or a glassy amorphous material (see column 6, lines 34-37)

As to claims 36, 39 and 49, Xu '444 teaches that any of the monocrystalline substances would work as the substrate (see column 6, lines 34-37). Therefore, it would have been obvious to one of ordinary skill in the art to select any of the monocrystalline substances for the substrate.

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum as applied to claim 30 above, and further in view of USP 5,157,304 to Kane.

Xu '444 does not disclose that its field emission device can be used in imaging systems. Kane '304 does teach that field emission devices can be used in imaging systems (see column 1, lines 12-24). It would have been obvious to one of ordinary skill at the time of this invention to use the field emission device in an imaging system as suggested by Kane '304.

Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum as applied to claim 30 above, and further in view of USP 6,054,801 to Hunt.

Xu '444 does not disclose that its field emission device can be used in a lighting system. Hunt '801 does teach that field emission devices can be used in lighting systems (see column 1,

lines 36-45). It would have been obvious to one of ordinary skill at the time of this invention to use the field emission device in a lighting system as suggested by Hunt '801.

Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum as applied to claim 30 above, and further in view of USP 6,465,132 to Jin taken with USP 6,911,767 to Takai.

Xu '444 discloses that the fiber emitter (nanorod) can be a carbide (see column 9, lines 25-32). Xu does not disclose all of the limitations of the claim. However, Jin '132 does disclose that the nanowire of its invention can be a nitride (see abstract for the discussion regarding using the nanowires in a field emission device, see also column 10, lines 32-56, which discloses what materials can be used to make the nanowires). Takai '767 discloses using silicides in field emission devices (see column 12, lines 66-67). It would have been obvious to use any of these other materials for the nanorods in the present filed emission device because the references teach that the other materials are effective in field emitter devices.

Claim 37 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum as applied to claims 30 and 44 above, and further in view of USP 6,376,007 to Rowell.

Xu '444 does not disclose the material used for the dielectric layer. Rowell '007 discloses that its dielectric material can be silicon dioxide or silicon nitride. It would have been obvious to use silicon dioxide or silicon nitride as the dielectric layer in the Xu reference because Rowell '007 teaches that these materials are dielectric.

Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 6,255,198 to Linthicum as applied to claim 38 above, and further in view of USP 6,586,093 to Laude.

As to claim 41, Xu does not disclose the use of nanoribbons in a field emission device. However, Laude '093 discloses different nanostructures (including nanoribbons, see column 1, lines 7-11) that can be used in field emission devices (see column 4, lines 20-22).

Claims 54 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 5,406,123 to Narayan.

As to claim 54, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is called a patterned gate metal film); and carbon fiber emitters (nanorods) (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly. However, Xu does not teach a polycrystalline diffusion barrier affixed to the top of the side of the substrate. Narayan '123 teaches that titanium nitride films and coatings having polycrystalline structure have applications such as diffusion barriers in integrated circuit devices. As such, it would have been obvious to one of ordinary skill in the art at the time of this invention to add a polycrystalline diffusion barrier to the top of the substrate in Xu in order to prevent diffusion or to retard the inter-diffusion of the two superposed metals.

As to claim 55, Xu '444 discloses a field emission device comprising a substrate (see abstract and column 5, lines 24-30, see also figure 1) that can be an inorganic monocrystalline substance (see column 6, lines 33-35). Specifically, a silicon wafer can be used (see column 20, lines 12-14). As can be seen in Figure 1, there are several nanostructures extending from the substrate. Xu discloses that these nanostructures are carburized metal (referred to as carbon fiber emitters) (see column 9, lines 25-32). However, Xu does not teach a polycrystalline diffusion barrier affixed to the top of the side of the substrate. Narayan '123 teaches that titanium nitride films and coatings having polycrystalline structure have applications such as diffusion barriers in integrated circuit devices. As such, it would have been obvious to one of ordinary skill in the art at the time of this invention to add a polycrystalline diffusion

barrier to the top of the substrate in Xu in order to prevent diffusion or to retard the inter-diffusion of the two superposed metals.

Claims 30, 35, 36, 38-40, 42-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman.

As to claims 30, 38, and 40, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is called a patterned gate metal film); and carbon fiber emitters (nanorods) (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly. Xu '444 teaches a conductive resistor layer on top of the substrate (see column 6, lines 11-29). However, Xu does not teach that the resistor layer is a conductive epitaxial layer. Paranthaman discloses a epitaxial article having a substrate and a conductive epitaxial buffer layer and an active layer (see paragraph 0035). It would have been obvious to one of ordinary skill in the art at the time of this invention to use a conductive epitaxial buffer layer (as in Paranthaman on the substrate of Xu because Paranthaman teaches that the use of epitaxial layers permit the formation of improved devices (see Paranthaman paragraph 0004). Further, the conductive epitaxial layer would serve the same function as the layer of Xu, which desires a conductive layer in order to ensure that lost electrons are replaced (see Xu, column 6, lines 11-13).

As to claim 44, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is called a patterned gate metal film); Xu discloses a catalyst metal film (since the catalyst is metal, it will serve as a conductive platform) on top of the substrate; with carbon fiber emitters (nanorods) on the metal (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly.

With regard to claims 35 and 48, the substrate of Xu can be an inorganic monocrystalline substance (see column 6, lines 33-35). Specifically, a silicon wafer can be used (see column 20, lines 12-14).

As to claim 42, Xu '444 discloses carbon fiber emitters having diameters of 20-100 nm (see column 19 lines 65-67).

As to claim 43, Xu discloses carburized metal (referred to as carbon fiber emitters) (see column 9, lines 25-32). Xu teaches a silicon carbide (see column 9, lines 30-31). Although Xu does not disclose where the carburized metal is from, it would have been obvious to use any of the metal oxides claimed in the present invention to provide the carburized metals.

As to claim 45, Xu '444 discloses a structure on top of the substrate, which can be a cone (see column 14, lines 22-32).

As to claim 46, Xu '444 teaches that the catalyst (the conductive layer) can be a transition metal, including molybdenum, platinum, palladium and niobium (see column 9, lines 26-39).

As to claim 47, Xu '444 discloses that the fiber emitter (nanorod) can be a carbide (see column 9, lines 25-32).

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Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman as applied to claim 30 above, and further in view of USP 5,157,304 to Kane.

Xu '444 does not disclose that its field emission device can be used in imaging systems. Kane '304 does teach that field emission devices can be used in imaging systems (see column 1, lines 12-24). It would have been obvious to one of ordinary skill at the time of this invention to use the field emission device in an imaging system as suggested by Kane '304.

Claim 33 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman as applied to claim 30 above, and further in view of USP 6,054,801 to Hunt.

Xu '444 does not disclose that its field emission device can be used in a lighting system. Hunt '801 does teach that field emission devices can be used in lighting systems (see column 1, lines 36-45). It would have been obvious to one of ordinary skill at the time of this invention to use the field emission device in a lighting system as suggested by Hunt '801.

Claim 34 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman as applied to claim 30 above, and further in view of USP 6,465,132 to Jin taken with USP 6,911,767 to Takai.

Xu '444 discloses that the fiber emitter (nanorod) can be a carbide (see column 9, lines 25-32). Xu does not disclose all of the limitations of the claim. However, Jin '132 does disclose that the nanowire of its invention can be a nitride (see abstract for the discussion regarding using the nanowires in a field emission device, see also column 10, lines 32-56, which discloses what materials can be used to make the nanowires). Takai '767 discloses using silicides in field emission devices (see column 12, lines 66-67). It would have been obvious to use any of these other materials for the nanorods in the present filed emission device because the references teach that the other materials are effective in field emitter devices.

Claim 37 and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman as applied to claims 30 and 44 above, and further in view of USP 6,376,007 to Rowell.

Xu '444 does not disclose the material used for the dielectric layer. Rowell '007 discloses that its dielectric material can be silicon dioxide or silicon nitride. It would have been obvious to use silicon dioxide or silicon nitride as the dielectric layer in the Xu reference because Rowell '007 teaches that these materials are dielectric.

Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of US 2002/0198112 to Paranthaman as applied to claim 38 above, and further in view of USP 6,586,093 to Laude.

As to claim 41, Xu does not disclose the use of nanoribbons in a field emission device. However, Laude '093 discloses different nanostructures (including nanoribbons, see column 1, lines 7-11) that can be used in field emission devices (see column 4, lines 20-22).

Claims 54 and 55 are rejected under 35 U.S.C. 103(a) as being unpatentable over USP 5,973,444 to Xu in view of USP 5,406,123 to Narayan.

As to claim 54, Xu '444 discloses a field emission device comprising a substrate; a dielectric layer; a conductive layer (in the Xu reference, the conductive layer is called a patterned gate metal film); and carbon fiber emitters (nanorods) (see abstract and column 5, lines 24-30, see also figure 1 and column 14, lines 40-43). As can be seen in Figure 1, Xu discloses a cavity extending downwardly. However, Xu does not teach a conductive polycrystalline diffusion barrier affixed to the top of the side of the substrate. Narayan '123 teaches that titanium nitride (titanium nitride is known to be conductive) films and coatings having polycrystalline structure have applications such as diffusion barriers in integrated circuit devices. As such, it would have been obvious to one of ordinary skill in the art at the time of this

invention to add a polycrystalline diffusion barrier to the top of the substrate in Xu in order to prevent diffusion or to retard the inter-diffusion of the two superposed metals.

As to claim 55, Xu '444 discloses a field emission device comprising a substrate (see abstract and column 5, lines 24-30, see also figure 1) that can be an inorganic monocrystalline substance (see column 6, lines 33-35). Specifically, a silicon wafer can be used (see column 20, lines 12-14). As can be seen in Figure 1, there are several nanostructures extending from the substrate. Xu discloses that these nanostructures are carburized metal (referred to as carbon fiber emitters) (see column 9, lines 25-32). However, Xu does not teach a conductive polycrystalline diffusion barrier affixed to the top of the side of the substrate. Narayan '123 teaches that titanium nitride films (titanium nitride is known to be conductive) and coatings having polycrystalline structure have applications such as diffusion barriers in integrated circuit devices. As such, it would have been obvious to one of ordinary skill in the art at the time of this invention to add a polycrystalline diffusion barrier to the top of the substrate in Xu in order to prevent diffusion or to retard the inter-diffusion of the two superposed metals.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rebecca M. Stadler whose telephone number is 571-272-5956.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stanley Silverman can be reached on 571-272-1358. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

rms

STUART L. HENDRICKSON
PRIMARY EXAMINER